Another Tevatron Puzzle: Bunch Length Blow-Ups at 980 GeV

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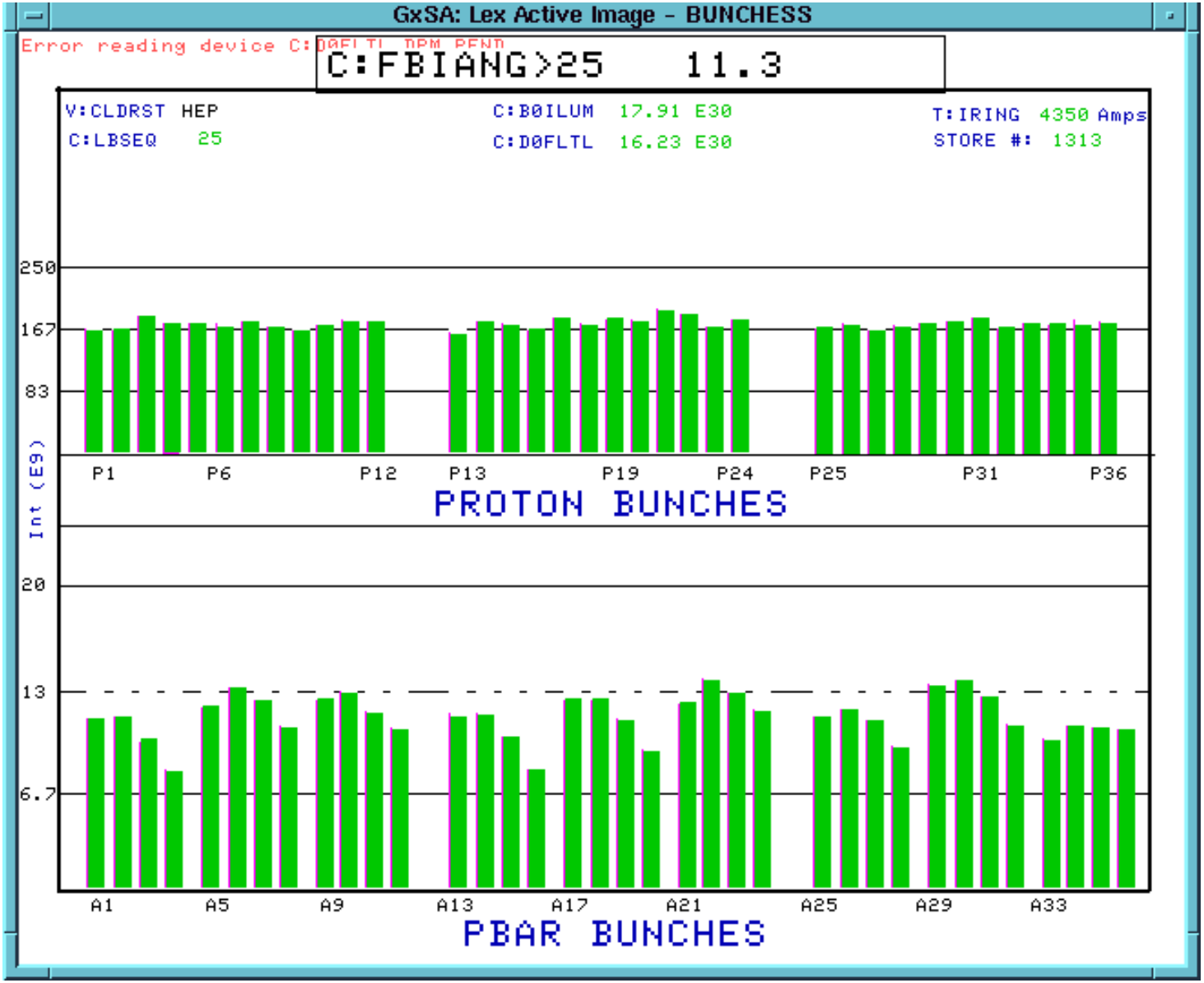
…This phenomena does not affect the Tevatron luminosity (much) but results in higher background rate and (probably) more DC beam [both are unpleasant]

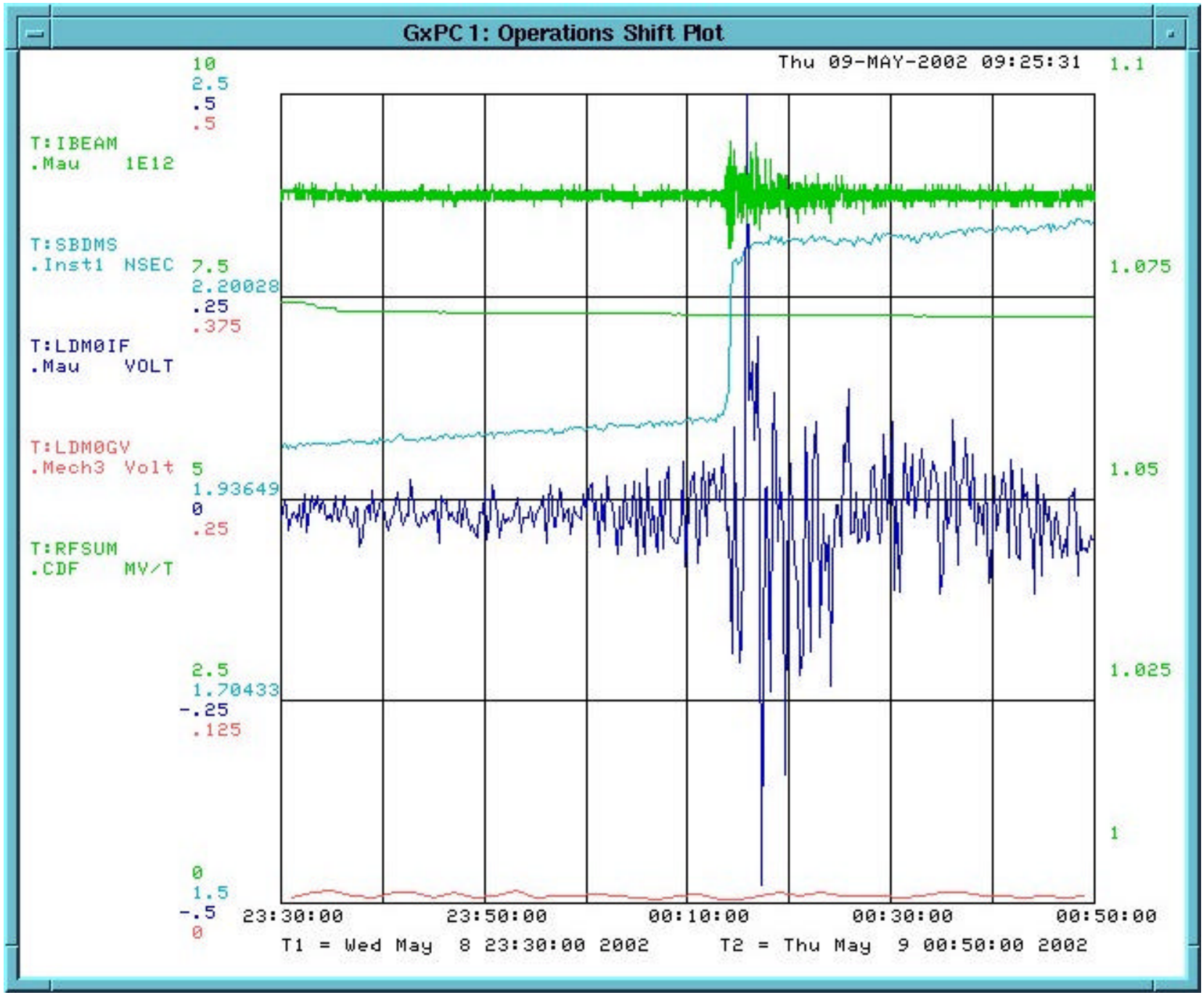
Beam intensities early in store 1313



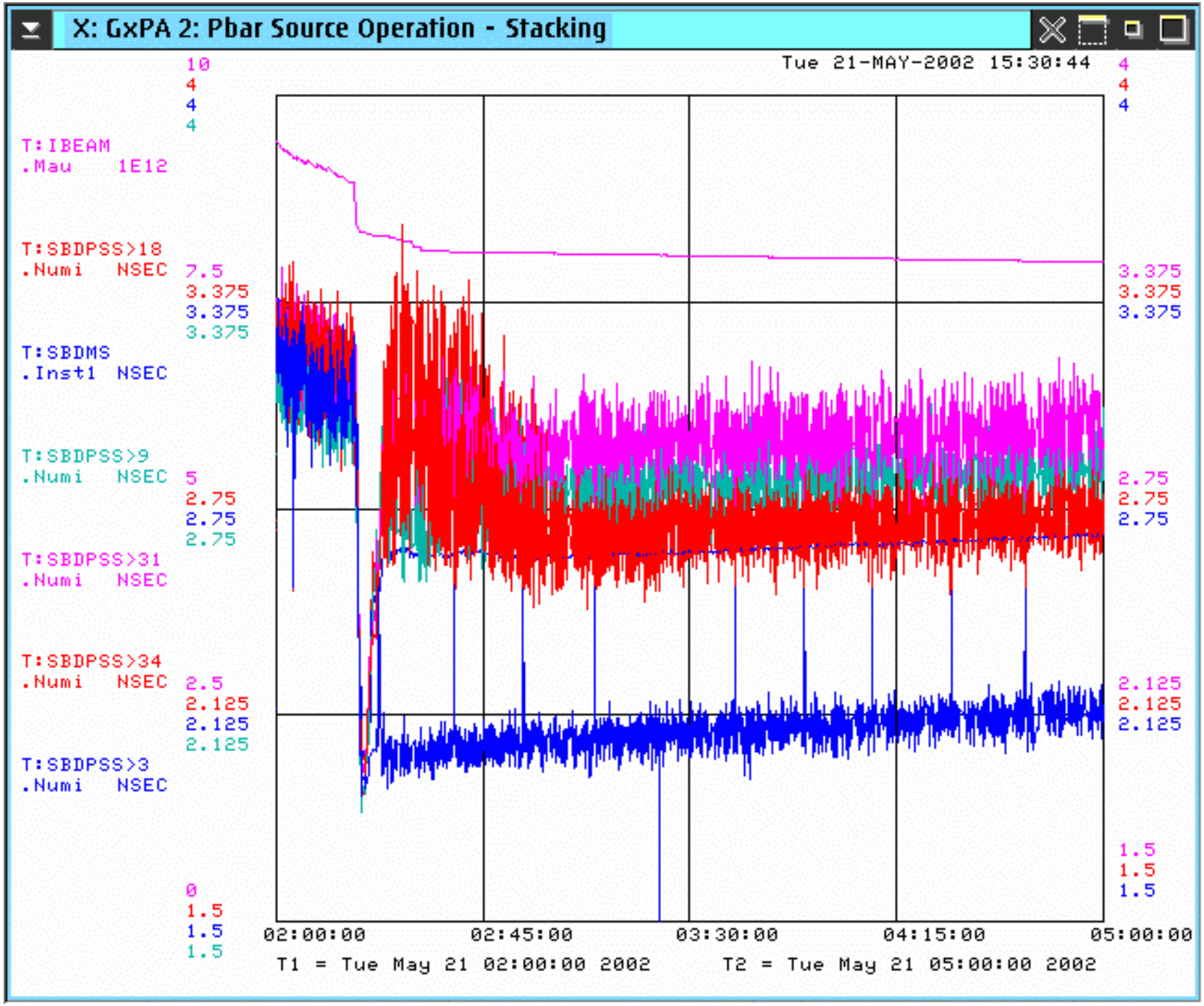
Some 7% variation in proton bunch intensity

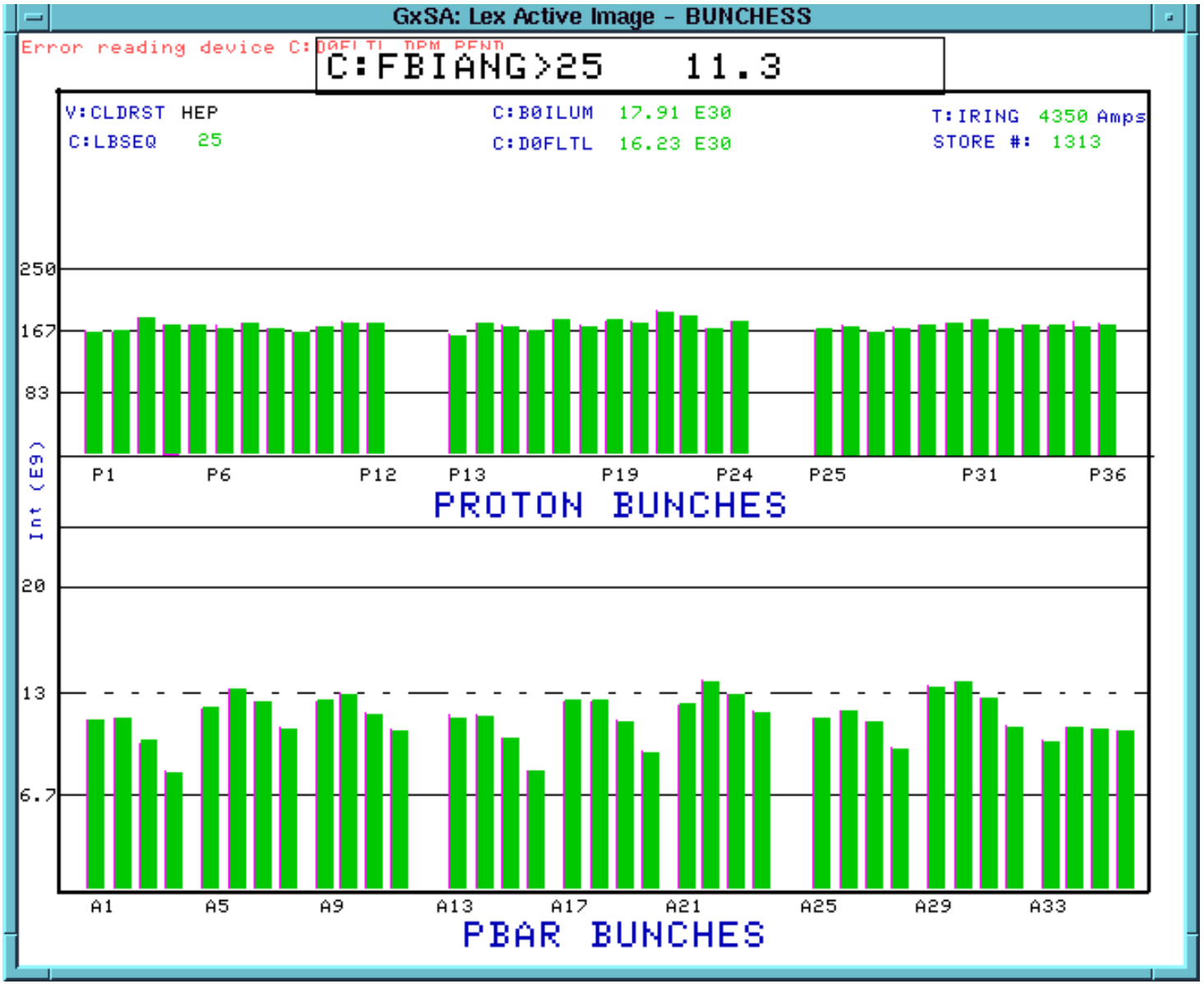
<N_p>=180e9/bunch and 30% in pbars <N_pbar>=11e9/bunch

Typical “sigma_s” blow-up event 05/08/2002.



“Badly” behaving bunches #9,18,31,34, others are “good”





while there is only some 5% variation in proton bunch intensity <N_p>=180e9/bunch vs 35% in pbars <N_pbar>=11e9/bunch

"~Facts" about the sigma_s blow-ups:

1. Before April'02 we did not see these blow-up (at all?); proton bunch intensity at 980 GeV did not exceed 130-150 e9/bunch
2. There were 11 "blow-up events in 36 HEP stores during March 24-May 8 (N_p about 1500→170e9/bunch)
3. More statistics on recent stores - 8 events in 12 stores

A	B	C	D	E	F	G	H
1302 8 May 230	170e9	2.0ns	2.3 ns	60 min	42hrs	67hrs	bad
1305 9 May 190	167e9	2.0ns	2.3ns	6 min	12hrs	43hrs	bad
1307 10May 180	179e9	2.0ns			53hrs		good
1309 11May 130	171e9	2.0ns			42hrs		good
1313 12May 060	176e9	2.0ns			40hrs		good
1328 16May0200	186e9	?	?	?	?	bad. SBDMS data not recor	
1329 16May1800	176e9	1.9ns	2.2ns	3 min	??	77 hrs	really bad
1332 17May1930	178e9	1.9ns	2.4ns	6 min	9hrs	83 hrs	really bad
1333 18May 173	181e9	2.1ns			50hrs		good
1335 19May1200	177e9	2.0ns	2.2ns	39 min	40hrs	59 hrs	bad
1337 20May0540	183e9	2.0ns	2.2ns	16 min	19hrs	56 hrs	bad
1340 21May0200	194e9	2.0ns	2.6ns	2 min	?	?	really bad

A – store, date, time; B- total N_p; C, D- sigma_s before and after the blow-up; E- time in the store; F, G- dσ/dt before and after, H-comment

Comments:

a) initial emittance is large (~ ½ RF bucket area at flat top) - we need to know what will happen with 3 times smaller emittances

b) there is natural growth σ_s=2 + (0.03-0.1)ns/hr – consistent with known RF noises (some 60 urad in RF phase or/and 70V in voltage), “microphonics” idea

c) blow-up amplitude varies between 0.2-0.6 ns for RMS σ_s, often occur early in the store

d) sometimes repetitive blow-ups occur (seems like σ_s → 2.6ns)

e) longitudinal feedback does not help much to reduce the natural growth(due to own noises?) and avoid the blow-ups

f) there are growing dipole longitudinal oscillations before the blow-up, after the blow-up the oscillations vanish very slowly (1/2 hour) – why? (compare – we have no longitudinal oscillations due to RF glitches)

g) there are oscillations of the RF voltage induced by beam oscillations.

h) the amplitude of the effect varies for different bunches

i) seems that bunch intensity matters (more frequent blow-ups at higher intensity, but why not every store?)

j) our ideas – HOM experiment (align frequencies), vary RF voltage